Chinese Pond Mussel (*Sinanodonta woodiana*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2011
Revised, July 2015

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1 Native Range, and Status in the United States

Native Range

From Benson (2015):

"Eastern Asia, primarily from the Amur River and Yangtze rivers (Kraszewski and Zdanowski, 2007)"

Status in the United States

From Benson (2015):

"In 2010, the first and only documented occurrence in the United States was in ponds of a former fish farm in Franklin Township, New Jersey (J. Bowers-Altman, pers comm.)."

"Established locally in the ponds."

Means of Introductions in the United States

From Benson (2015):

"Most likely the mussels arrived as glochidia (larvae) attached to the gills of imported Asian carp (Beran, 2008). All carp species serve as hosts for the glochidia larval stage."

Remarks

From Benson (2015):

"The New Jersey fish farm was purchased by the New Jersey Conservation Foundation for conservation purposes. All the fish, of which some were apparently bighead carp (*Hypophthalmichys nobilis*), an invader in itself, were eradicated with a rotenone treatment (J. Bowers-Altman, pers comm.)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2015):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Lophozoa
Phylum Mollusca
Class Bivalvia
Subclass Palaeoheterodonta
Order Unionoida
Superfamily Unionoidea
Family Unionidae
Subfamily Unioninae
Tribe Anodontini
Genus Sinanodonta
Species Sinanodonta woodiana (Lea, 1834)"

"Taxonomic Status: valid"

Size, Weight, and Age Range

From Benson (2015):

"Reaching 30 cm (Pou-Rovira et al., 2009)"

From Domagała et al. (2007):

"According to DUDGEON and MORTON (1983) the mussels reproduce already in the first year of life having reached the shell length of 3-4 cm. Nevertheless, KONDO (1987) in the Asahi River (Japan) found a 2 year old female of the shell length of 4.46 cm that had just matured for reproduction."

From Popa and Popa (2006):

"The individuals can live between 12 – 14 years."

Environment

From Cummings (2011):

"This species is a habitat generalist found in heavily modified and artificial habitats and is tolerant to high siltation rates (Paunovic et al. 2006). In the Czech Republic it is found in ponds, oxbow lakes and canals (Beran 2008). It prefers substrates of silt and clay, turbid conditions with relatively high water temperatures (30-33° C) and is found in either standing or slow-flowing water (Soroka 2005, Zettler and Jueg 2006)."

Climate/Range

From Colomba et al. (2013):

"Thermal conditions, water flow and substrate characteristics mostly determine the distribution and density of S. woodiana (Kraszewski & Zdanowski, 2007). According to Demayo et al. (2012), this species prefers habitats with higher temperatures (the optimal thermal conditions vary within 10 and 35ºC)."

Distribution Outside the United States

Native

From Cummings (2011):

"Its native range is uncertain, but ranges from Indochina and China, north to Korea, Japan, Primorye and the Amur Basin in eastern Russia (Graf 2007). The species native range in Indochina is unclear; it appears to be native to Viet Nam (from 'Cochin' as the synonym *Anodonta jourdyi* Morelet, 1886) and perhaps Cambodia, but Brandt (1974) considers the species to have been introduced to Thailand, Malaysia, Singapore, and other countries in southeast Asia."

Introduced
From Cummings (2011):

"Austria; Belgium; Bulgaria; Costa Rica (Costa Rica (mainland)); Czech Republic; Dominican Republic; France (France (mainland)); Germany; Hungary; Indonesia; Italy (Italy (mainland)); Malaysia (Peninsular Malaysia, Sabah, Sarawak); Philippines; Poland; Romania; Serbia (Serbia, Serbia); Singapore; Slovenia; Spain (Spain (mainland)); Sweden; Ukraine (Ukraine (main part)); United States (New Jersey)"

Means of Introduction Outside the United States

From Cummings (2011):

"It was first introduced to Europe in 1963 along with introduced carp"

From Colomba et al. (2013):

"The great success of *S. woodiana* has been attributed to the worldwide introduction for commercial purposes of its sympatric fish hosts (mainly carp species from East Asia) (Watters, 1997[a])."

Short description

From Colomba et al. (2013):

"wide shell (maximum length ca. 300 mm), with deeply rounded ventral margin, surface irregularly rippled to corrugated, umbonal rugae prominent widely spaced, subconcentric or slightly transverse ripples without prominent nodules, posterior pedal retractor scar very narrow; hinge without teeth"

Biology

From Colomba et al. (2013):

"*S. woodiana* larvae, like all Unionidae (Castagnolo et al., 1980; Aldridge & McIvor, 2003), go throught an obligatory parasitic stage (known as glochidium); glochidia larvae parasitize, by clinging with a kind of hook, the fins or gills of fish for several days to weeks; afterwards they detach from the host and fall to the bottom where mature and start to conduct a free life."

"*S. woodiana* is a broad generalist, and it may parasitize even on novel native hosts (Kiss,1995; Watters, 1997[a]; Sárkány-Kiss et al., 2000; Douda et al., 2012), in addition both juveniles and adults of *S. woodiana* can successfully cope with a wide range of environmental conditions."

From Popa and Popa (2006):

"Glochidia are discharged within the period May – August (mainly in June and July), and this species can develop 2 – 3 larval stages per year, being in contrast with the native species which

reproduce once a year. Parasitic period lasts between 5 and 15 days, depending on the water temperature."

Human Uses

From Cianfanelli et al. (2007):

"There are some significant examples of introductions related to commercial activity. This is the case of *A. woodiana*, introduced into Tuscany not only unintentionally but also specifically for the production of artificial pearls (Berni et al. 2004)."

From Packet et al. (2009):

"The species is sold in garden centres as a "biofilter" for garden ponds."

Diseases

No OIE-listed diseases have been reported for this species.

Threat to humans

No information available.

3 Impacts of Introductions

From Cappelletti et al. (2009):

"The presence of *S. woodiana* could seriously influence the indigenous unionid populations, as has been already observed in other Italian locations. Fabbri and Landi (1999) reported that *A. anatina* has been replaced almost completely by *S. woodiana* in some channel with soft substrate and high trophic level; Niero (2003), in a channel with a high trophic level located in Venezia province, where a high density of *A. anatina* (up to 10 adult specimens m-2) was recorded in 1987, noted the exclusive presence of *S. woodiana* in 2002."

"Fabbri and Landi (1999), Rashleight (1995), and Watters (1997a, b) argue that native species reduction could be caused by competition for the host fish, because of the major infestation capacity of alien *Anodonta* species glochidia. Competition among larval stages is highly probable when *S. woodiana* becomes the dominant species (Beran 2008). Food and habitat competition between *S. woodiana* and native unionids was instead excluded by Kraszewski and Zdanowski (2007), in a peculiar artificial lake system heated by power plant discharge in central Poland."

From Cianfanelli et al. (2007):

"Competition with other indigenous species, especially other *Anodonta*, some populations of which are already showing disquieting signs of rarefaction (Fabbri and Landi 1999, Niero 2003), has been observed."

From Bódis et al. (2014a):

"The modification of the macroinvertebrate community structure by empty bivalve shells on bottom texture of silt and sand was marked by an increase in amphipods, caddis larvae, isopods and gastropods, and a decrease in bivalves, chironomids and oligochaetes (i.e. the empty shells facilitate mainly the epifaunal and inhibit the presence of infaunal elements).

"Our results showed that the individual larger shelled unionids *A. anatina* and *S. woodiana* attracted a denser and more diverse macroinvertebrate community than the smaller shelled *C. fluminea* and the mixed shells of different sizes."

"In the Danube River, both *C. fluminea* and *S. woodiana* are widespread and capable of producing large amounts of empty shells due to their massive mortality during extreme climatic events (Bódis et al., 2014[b]). Given the widespread distribution, high density and the relatively long-term persistence of their empty shells, their habitat modifying effects can be particularly important."

4 Global Distribution

Figure 1. Known native distribution of *S. woodiana*. Map from GBIF (2015).

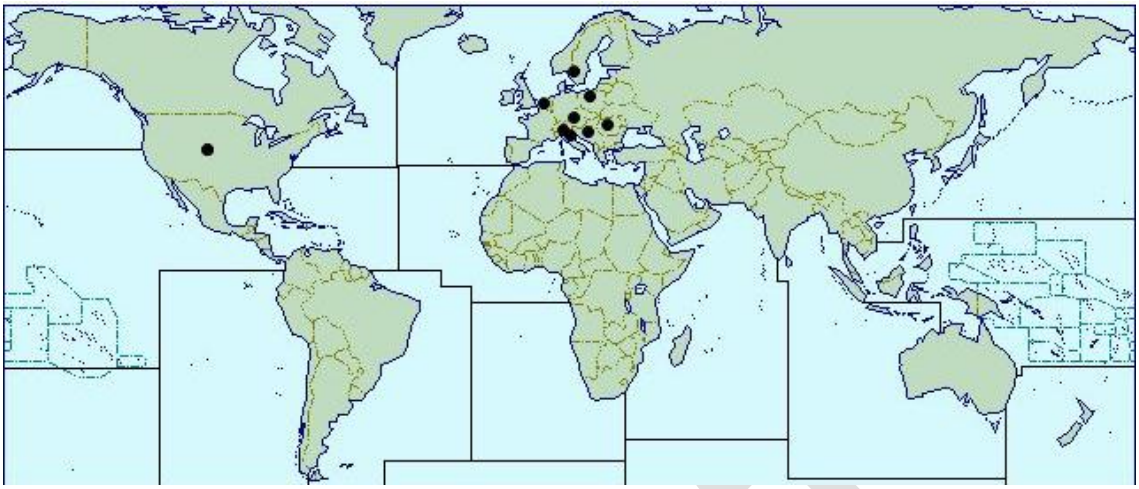

Figure 2. Known introduced distribution of *S. woodiana*. Map from CABI (2015).

5 Distribution within the United States

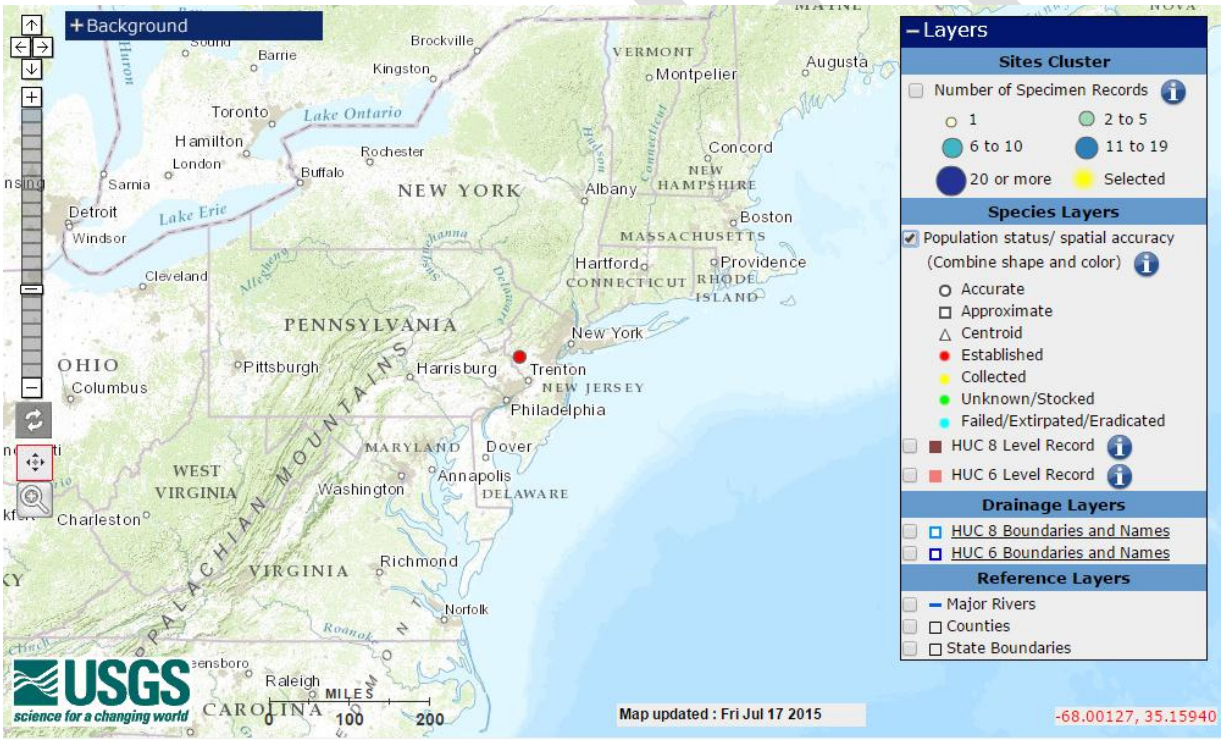

Figure 3. U.S. distribution of *S. woodiana*. Map from Benson (2015).

6 Climate Match

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2014; 16 climate variables; Euclidean Distance) is very high in the Northeast and Mid-Atlantic regions. Climate match is also medium to high in the Great Lakes and the Southern Plains. Medium climate match appears in portions of Florida and the Interior West. The West Coast, North Central region, and much of the Southeast are low climate

matches. Climate 6 match indicates that the US has a high climate match. The range for a high climate match is 0.103 and greater; Climate 6 score of *S. woodiana* is 0.303.

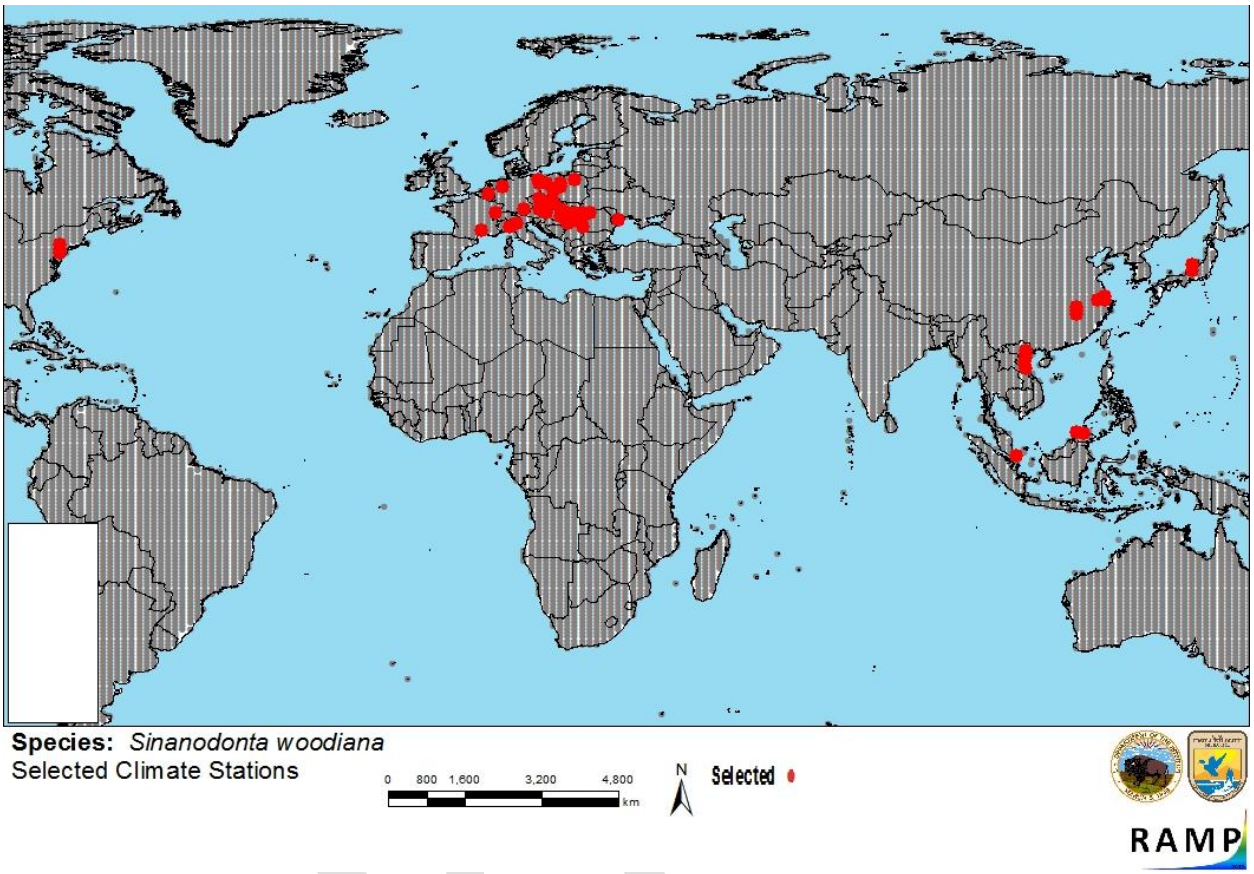

Figure 4. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *S. woodiana* climate matching. Source locations from Kraszewski (2007), Cummings (2011), and GBIF (2015).

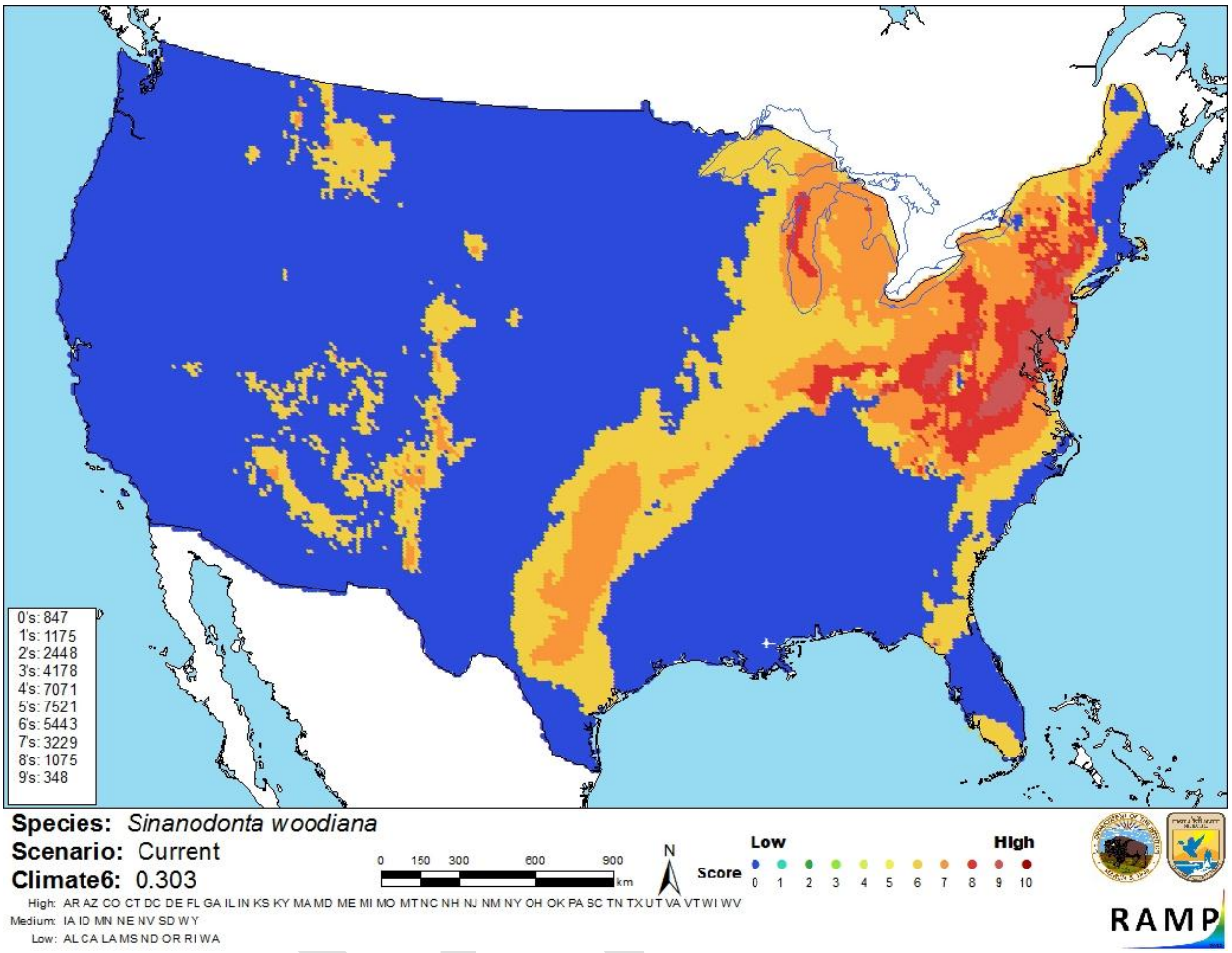

Figure 5. Map of RAMP (Sanders et al. 2014) climate matches for *S. woodiana* in the continental United States based on source locations reported by Kraszewski (2007), Cummings (2011), and GBIF (2015). 0= Lowest match, 10=Highest match. Climate match scores are tabulated on left.

7 Certainty of Assessment

Information on the biology, distribution, and impacts of *S. woodiana* is available but not abundant. Negative impacts from introductions have been documented in the scientific literature, but further study would help characterize these impacts further. Certainty of assessment is medium.

8 Risk Assessment

Summary of Risk to the Continental United States

Sinanodonta woodiana, a unionid mussel species from East Asia, has been introduced widely through transport with Asian carp species during the mussel's parasitic larval stage. This species is known to outcompete native mussels in life, and alter macroinvertebrate community structure with the presence of its empty shells in death. *S. woodiana* has already successfully established at one location in the US. Risk exists for additional introductions and establishment in the eastern

and midwestern United States as climate match is high and this species spreads rapidly. Overall risk of this species is high.

Assessment Elements

- **History of Invasiveness (Sec. 3):** High
- **Climate Match (Sec. 6):** High
- **Certainty of Assessment (Sec. 7):** Medium
- **Overall Risk Assessment Category: High**

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